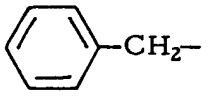
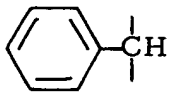
named as an alkyl, alkenyl, or arylbenzene, unless for some reason the compound has a trivial name. The hydrocarbon group (C_6H_5—) from benzene itself is called a phenyl group and is sometimes abbreviated as the symbol ϕ or as Ph. Aryl groups in general are often abbreviated as Ar.

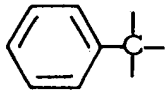
Other groups which have trivial names include the following:



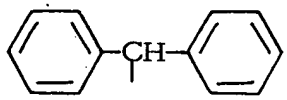
benzyl



benzal

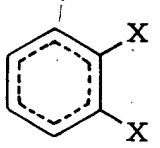


benzo

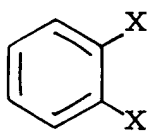


benzhydryl

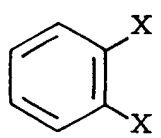
When there are two or more substituents on a benzene ring, position isomerism arises. Thus, there are three possible isomeric disubstituted benzene derivatives according to whether the substituents have the 1,2, 1,3, or 1,4 relationship. The isomers are commonly designated as *ortho, meta,* and *para* (or *o, m,* and *p*) for the 1,2-, 1,3- and 1,4-isomers respectively. The actual symmetry of the benzene ring is such that only one 1,2-disubstitution product is found despite the fact that two would be predicted if benzene had the 1,3,5-cyclohexatriene structure.

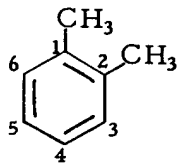


not

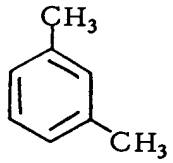


and

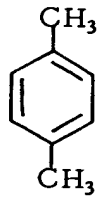




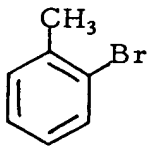
ortho-xylene
(1, 2-dimethylbenzene)



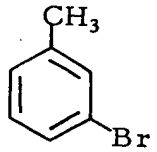
meta-xylene
(1, 3-dimethylbenzene)



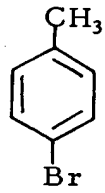
para-xylene
(1, 4-dimethylbenzene)



o-bromotoluene



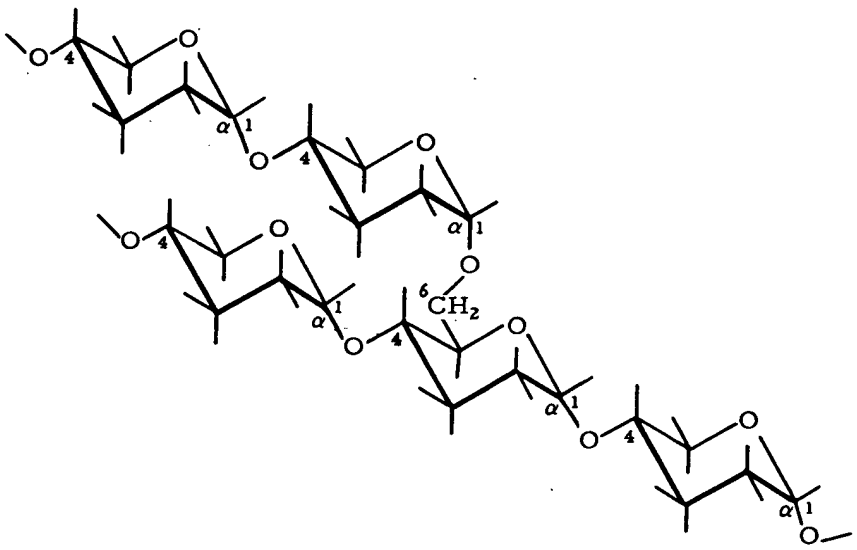
m-bromotoluene



p-bromotoluene

EXERCISE 22-1 How many isomeric products could each of the xylenes give on introduction of a third substituent? Name each isomer using chlorine as the third substituent.

Basic Principles



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196

# of Organic Chemistry

by **JOHN D. ROBERTS**

Professor of Organic Chemistry

and **MARJORIE C. CASERIO**

Senior Research Fellow of Chemistry

CALIFORNIA INSTITUTE OF TECHNOLOGY

1965 NEW YORK · AMSTERDAM

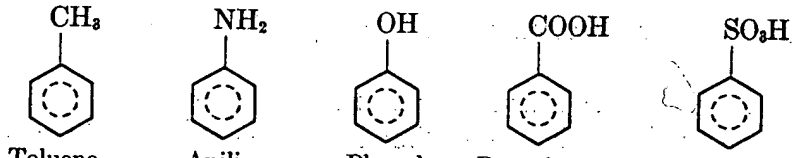
Basic Principles of
Organic Chemistry

Library of Congress Catalog Card Number 64-16071
Manufactured in the United States of America

The manuscript was put into production March 13, 1963, and this volume was published June 15, 1964; second printing, with corrections, March 5, 1965; third printing, with corrections, September 10, 1965.

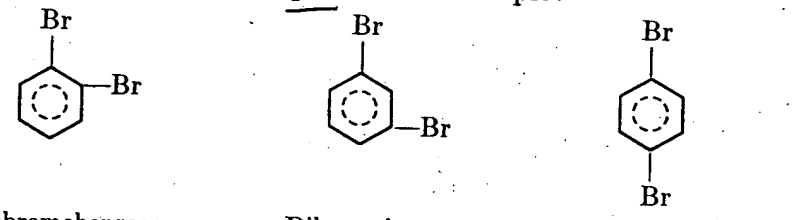
The publisher is pleased to acknowledge the assistance of Sophie Adler, who designed the book, and Russell F. Peterson, who drew many of the illustrations

W. A. Benjamin, Inc.
NEW YORK, NEW YORK



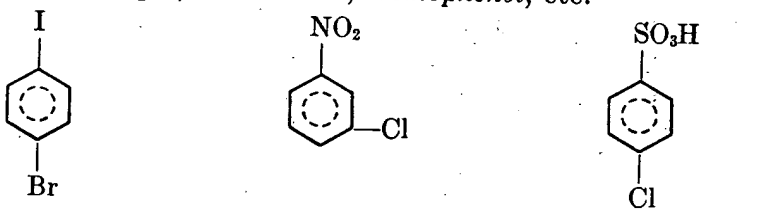
Toluene Aniline Phenol Benzoic acid Benzenesulfonic acid

If several groups are attached to the benzene ring, we must not only tell what they are, but also indicate their relative positions. The three possible isomers of a disubstituted benzene are differentiated by the use of the names, ***ortho, meta,*** and ***para.*** For example:

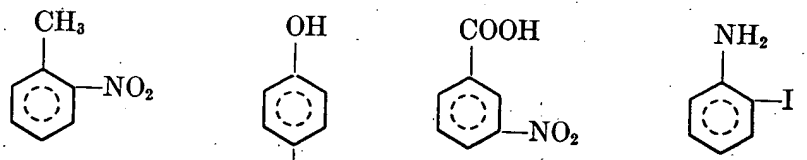


o-Dibromobenzene *ortho* *m*-Dibromobenzene *meta* *p*-Dibromobenzene *para*

If the two groups are different, and neither is a group that gives a special name to the molecule, we simply name the two groups successively and end the word with *-benzene;* for example, *chloronitrobenzene, bromoiodobenzene,* etc. If one of the two groups is the kind that gives a special name to the molecule, then the compound is named as a derivative of that special compound; for example, *nitrotoluene, bromophenol,* etc.

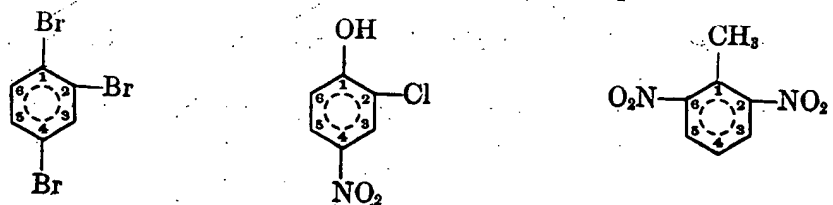


p-Bromoiodobenzene *m*-Chloronitrobenzene *p*-Chlorobenzenesulfonic acid



o-Nitrotoluene *p*-Bromophenol *m*-Nitrobenzoic acid *o*-Iodoaniline

If more than two groups are attached to the benzene ring, numbers are used to indicate their relative positions. For example:



1,2,4-Tribromobenzene 2-Chloro-4-nitrophenol 2,6-Dinitrotoluene

ORGANIC CHEMISTRY

First printing . . . . . July, 1959
Second printing . . . . June, 1960

Library of Congress catalog card number: 59–10054

PRINTED IN THE UNITED STATES OF AMERICA

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trorotatory (D+), and is the only form having vitamin activity.
Sources: Food sources: liver, kidney, yeast, crude molasses, milk, whole grain cereals, rice. Commercial sources: produced synthetically from 2,4-dihydroxy-3,3-dimethylbutyric acid and beta-alanine. See calcium pantothenate.

pantothenol (D[+]-pantothenyl alcohol; panthenol, USAN name)
$HOCH_2C(CH_3)_2CHOHCONH(CH_2)_2CH_2OH$. The alcohol corresponding to pantothenic acid, with vitamin activity.
Properties: Viscous liquid; soluble in water, ethanol, methanol; specific rotation +28.36° to 30.7° in water (c = 5); refractive index 1.497 (20°C).
Uses: Biochemical research; food additive and dietary supplement.

papain (papayotin)
Properties: White or gray slightly hygroscopic powder; soluble in water and glycerine; insoluble in other common organic solvents. The most thermostable enzyme known. Digests proteins.
Derivation: Obtained as dried and purified latex of Carica papaya.
Grades: Technical; purified. Technical grade is susceptible to decompositoin in storage.
Containers: Glass bottles; lined fiber drums.
Uses: Meat tenderizer; other food industries (mainly to prevent protein haze on chilling beer); tobacco, pharmaceutical, cosmetic, leather, textiles.

papaverine $(CH_3O)_2C_6H_3CH_2C_9H_4N(OCH_3)_2$. 6,7-Dimethoxy-1-veratrylisoquinoline. An alkaloid.
Properties: White crystalline powder. Soluble in chloroform, hot benzene, aniline, glacial acetic acid, and acetone; slightly soluble in alcohol and ether; insoluble in water. M.p. 147°C.
Derivatoin: From opium.
Hazard: Moderately toxic narcotic.
Use: A vasodilator used for treatment of hypertension (also as the hydrochloride which is soluble in water.)

paper. A semisynthetic product made by chemically processing cellulosic fibers. Wide varieties of sources have been used for specialty papers (flax, bagasse, esparto, straw, papyrus, bamboo, jute, and others), but by far the largest quantity is made from softwoods (coniferous trees), such as spruce, hemlock, pine, etc.; some is also made from such hardwoods as poplar, oak, etc., as well as from synthetic fibers. Papermaking technology involves the following basic steps: (1) chipping or other subdivision of the logs (see groundwood); (2) manufacture of chemical or semichemical pulp by digestion in acid or alkaline solutions, which separates the cellulose from the lignin (see pulp, paper); (3) beating the pulp to break down the fibers and permit proper bonding when the sheet is formed; (4) addition of starches, resins, clays, and pigments to the liquid stock (or "furnish"); (5) formation of the sheet continuously on a fourdrinier machine, where the water is screened out and the sheet dried by passing over a series of heated drums; (6) high-speed calendering for brightness and finish; (7) coating, either by machine application or (for heavy finishes) by brushes.
Note: Wet paper stock and waste are flammable, and are considered as dangerous fire risks.
Further information can be obtained from the Technical Association of the Pulp and Paper Industry, 360 Lexington Ave., N.Y. (q.v.), or from the Institute of Paper Chemistry, Appleton, Wisconsin.

"Paperad."[489] Trademark for a finely precipitated trihydrated alumina pigment filler and extender for use in the paper industry. Characterized by high brightness and blue-white color.

paper chromatography (PC). A micro type of chromatography (q.v.). A drop of the liquid to be investigated is placed near one end of a strip of paper. This end is immersed in solvent, which travels down the paper and distributes the materials present in the original drop selectively. Comparison with known substances makes identification possible.

paper, coated. A paper that is covered on one or both sides with a suspension of clays, starches, casein, rosin, wax, or combinations of these, to serve special purposes. Machine-coated paper is required for standard book printing; the rather light coating is applied by a roll-coating device. Heavier coatings are applied as a final step by means of brushes or spreading devices. These are required for high-grade printing of magazines, art books, etc., where excellent photographic reproduction is essential. Special-purpose coatings, as for packaging, are applied in a separate operation.

paper, synthetic. Paper or paper-like material made from a polyolefin; polypropylene is usually selected. This product reached pilot-plant production stage in 1974. A paper made from styrene copolymer fibers has been developed to production stage in Japan. Plastic-coated cellulosic papers are available for children's books, posters, and similar applications.

"Papi."[520] Trademark for polymethylene polyphenylisocyanate. A dark non-volatile liquid; average viscosity 250 cp at 25°C. Used in one-shot rigid urethane foams.
"Papi" 50. 50% solution in monochlorobenzene. Used in adhesives (rubber to metals and synthetic fabrics); coating intermediate.

"Papricol."[342] Trademark for an oleoresin of paprika for food coloring and flavoring.

para- (p-). A prefix. For definition of para-compounds, see ortho-. For para-compounds, see specific compound; para-cresol is listed under cresol and para-dichlorobenzene under dichlorobenzene.

"Parabens."[583] Trademark for the methyl, propyl, butyl, and ethyl esters of para-hydroxybenzoic acid. Antimicrobial agents for foods and pharmaceuticals. Nontoxic. Approved by FDA.

paracasein. See casein.

paracetaldehyde. See paraldehyde.

"Paracol."[266] Trademark for a series of wax and wax-rosin emulsions produced from paraffin waxes, microcrystalline waxes, or combinations of these waxes with rosin. Used to impart water resistance to paper and allied materials.

"Paracort."[330] Trademark for prednisone (q.v.).

"Paracril."[248] Trademark for a group of synthetic rubbers of the Buna-N or nitrile type, produced by the copolymerization of butadiene and acrylonitrile. Resist deterioration by aliphatic hydrocarbon, mineral and vegetable oils, and animal fats and oils and are particularly resistant to petroleum products.

Van Nostrand Reinhold Company Regional Offices:
New York Cincinnati Atlanta Dallas San Francisco

Van Nostrand Reinhold Company International Offices:
London Toronto Melbourne

Library of Congress Catalog Card Number: 76-19024
ISBN: 0-442-23240-3

Manufactured in the United States of America

Published by Van Nostrand Reinhold Company
135 West 50th Street, New York, N.Y. 10020

Published simultaneously in Canada by Van Nostrand Reinhold Ltd.

15 14 13 12 11 10 9 8 7 6

Library of Congress Cataloging in Publication Data
Main entry under title:

The Condensed chemical dictionary.

1. Chemistry—Dictionaries. I. Hawley, Gessner Goodrich, 1905–
QD5.C5 1976 540'.3 76-19024
ISBN 0-442-23240-3

The Condensed Chemical Dictionary

NINTH EDITION

Revised by

GESSNER G. HAWLEY
Coeditor, Encyclopedia of Chemistry
Coauthor, Glossary of Chemical Terms

VAN NOSTRAND REINHOLD COMPANY
NEW YORK CINCINNATI ATLANTA DALLAS SAN FRANCISCO
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